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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : A61F 13/46, 13/15

A1

(11) International Publication Number: **WO 97/00656**

(43) International Publication Date: 9 January 1997 (09.01.97)

(21) International Application Number: PCT/US96/09074

(22) International Filing Date: 4 June 1996 (04.06.96)

(30) Priority Data:
08/494,273 23 June 1995 (23.06.95) US

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(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

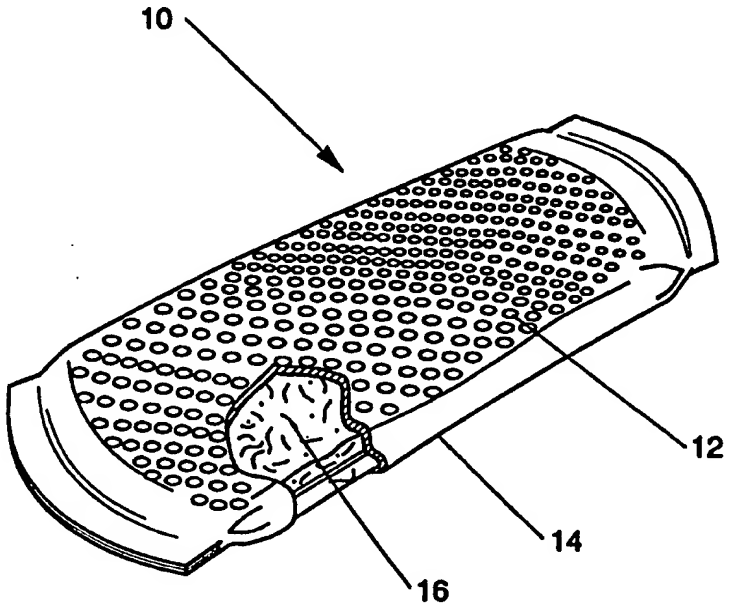
Published
With international search report.

reference 2

(54) Title: ABSORBENT DEVICE WITH IMPROVED FUNCTIONAL SURFACE

(57) Abstract

An absorbent device having improved tactile and dryness attributes created by applying a pattern of hydrophobic projections extending outwardly from the body facing surface of the absorbent device, the hydrophobic projections are adapted to contact the user and to separate the user from the body facing surface of the device thereby defining a plurality of containment areas between the projections for collecting and temporarily containing fluid emanating from the user. The pattern of hydrophobic projections improve the dryness characteristics by keeping the fluid away from the user of the absorbent device and impart comfort properties to the user by creating a soft surface.



ABSORBENT DEVICE WITH IMPROVED FUNCTIONAL SURFACE

FIELD OF THE INVENTION

This invention relates generally to absorbent devices having a web surface and more particularly to an absorbent device and method for improving the dryness and tactile attributes of the web surface. The invention will be specifically disclosed in connection with a rotary screen printing method for applying a plurality of hydrophobic projections to the web surface to improve the dryness and tactile attributes.

BACKGROUND OF THE INVENTION

It has long been known in the disposable absorbent product art that it is extremely desirable to construct absorptive devices, such as disposable diapers, sanitary napkins, and the like, presenting a dry surface feel to the user to improve wearing comfort and to minimize the development of undesirable skin conditions due to prolonged exposure to moisture absorbed within the product. Typical web materials used in the manufacture of absorbent devices include non-woven and tissue substrates. Non-woven and tissue substrates are problematic for web surfaces because once the web surface, also commonly referred to as a topsheet, has been soiled by bodily fluids such as urine or menstrual fluid, the web surface remains wet and prolonged exposure to the fluid absorbed by the web is experienced by the user.

With respect to tissue topsheets, surface wetness continues to be a significant problem. With respect to non-woven topsheets, an attempt to eliminate surface wetness has been addressed in U.S. Patent No. 4,041,951 issued to Sanford on August 16, 1977 and hereby incorporated by reference. The Sanford patent discloses a preferred disposable diaper structure comprising a substantially planar, moisture absorbent layer disposed between a soft topsheet and a moisture-resistant backing sheet. The non-woven fibrous topsheet preferably comprises an integral structure containing a multiplicity of depressed areas which intimately contact the upper most surface of a substantially planar, moisture absorbent layer. The non-depressed areas of the topsheet contact the wearer's skin in-use. The non-woven fibrous topsheet of

the diaper disclosed in Sanford is comprised of a substantially hydrophobic material exhibiting wet resilience such that the topsheet tends to resume its substantially three-dimensional character upon removal of pressure applied against the topsheet by the body movements of the wearer. The non-depressed areas of the topsheet, which are substantially the same density as the depressed areas, tend to isolate the wearer's skin from moisture contained within the moisture absorbent layer, thereby providing surface dryness and resistance to rewetting when the structure is temporarily subjected to pressure resulting from the wearer's bodily movements. Although Sanford addresses surface wetness problems with non-woven substrates, the problems associated with surface wetness have not been totally eliminated and this reference requires depressions substantially through the entire thickness of the web.

Another attempt at solving surface wetness problems in absorbent devices has been through the development of plastic film topsheets such as disclosed in U.S. Patent No. 3,929,135 issued to Thompson on December 30, 1975, and hereby incorporated by reference. Thompson suggests a topsheet comprised of liquid-impermeable material and is provided with tapered capillaries, the capillaries have a base opening in the plane of the topsheet and an apex opening remote from the plane of the topsheet. The topsheet disclosed in the Thompson patent allows the free transfer of fluids from the body into the absorbent element of the device while inhibiting the reverse flow of these fluids, resulting in a relatively much dryer surface in contact with the user than had been previously obtainable. However, contrary to expectations, it has been learned that despite the highly effective fluid transfer and fluid isolation characteristics exhibited by plastic topsheets of the type generally disclosed in the Thompson patent and their proven compatibility with the wearer's skin, many users find it psychologically undesirable to employ a material which is perceivably plastic in contact with the user's genital area. It is believed that this user reaction is due in part to the highly regulated tapered capillary pattern on the wearer-contacting surface of the topsheet and partly to the glossy appearance of the film. Users are prone to view both of these characteristics negatively when dealing with plastic films which will contact the user's skin.

Another problem associated with the use of tissue, non-woven or plastic film topsheets is that the tactile impression (or softness) of the topsheet is less than desirable. Considering that tissue or non-woven substrates consist of natural fibers such as wood pulp or synthetic fibers, the tactile impression of these substrates needs to be extremely soft when applied to the delicate tissues of the genital area. Although the tactile impression created by plastic film topsheets has proven to be quite good,

the psychological problems of a plastic material creates in some users the impression that the softness of the plastic film is not satisfactory.

Yet another problem associated with web substrates consisting of tissue, non-woven or plastic film materials is that once these topsheets are soiled, the topsheets are ineffective at masking the bodily fluid collected by the absorbent device. These topsheets remain dirty due to a phenomenon referred to as fluid hangup. Fluid hangup is a phenomenon where the bodily fluid sits on the surface of the topsheet and does not pass through the topsheet and into the absorbent component located below the topsheet. When the bodily fluid is menstrual fluid, components of the menstrual fluid such as blood clots and body tissue is of a consistency which prevents those components from passing through the topsheet and into the absorbent component. Also fluid contained within the storage component can be seen through the topsheet.

Therefore, there exists a need for an absorbent device having improved dryness and tactile attributes when the web surface comprises a non-woven or tissue substrate. There also exists a need for an absorbent device having improved tactile attributes when the web surface comprises a plastic film. There also exists a need for an absorbent device having either tissue, non-woven or plastic film web surfaces having improved masking capabilities.

SUMMARY OF THE INVENTION

The present invention provides an absorbent device and a method of improving the surface dryness and tactile attributes of the absorbent device. The present invention substantially reduces the surface wetness problems associated with prior absorbent devices having tissue or a non-woven material topsheet and provides these substrates with a surface dryness equal to that of a formed film topsheet. The invention also addresses the psychological problems associated with formed film topsheets by improving the tactile impression of the formed film topsheet. The invention also provides improvement in the masking characteristics of an absorbent device having web types of tissue, non-woven or formed film materials.

The improved absorbent device of the present invention is provided by a method of joining small regular or random patterned hydrophobic projections on the surface of the web without changing any of the fluid handling channels of the web material. The plurality of projections are adapted to contact the user and to separate the user from the body facing surface of the topsheet. The hydrophobic projections further define a plurality of fluid containment areas between the projections for collecting and temporarily containing bodily fluid emanating from the user. The hydrophobic projections separate the fluid from the user to improve the dryness

attributes, and improve the tactile impression of the absorbent device by imparting comfort properties to the user.

The material that can be joined to the web surface can be any hydrophobic material that can be printed or sprayed. These include, but are not limited to, thermal plastics and hot melt resins. The material can be joined by any printing or spraying method, wherein rotary screen printing is preferred. Other apparatus and processes suitable for use with the claimed invention is exemplified by that disclosed in U.S. Patent No. 5,058,247 issued to Thomas, et al. on October 22, 1991; U.S. Patent No. 5,116,563 issued to Thomas, et al. on May 26, 1992; and U.S. Patent No. 5,230,851 issued to Thomas on July 27, 1993, said patents being hereby incorporated by reference. The apparatus and processes disclosed in the Thomas, et al. patents can be utilized as an alternative to the preferred rotary screen printing process.

The rotary screen printing process comprises the steps of pumping molten hydrophobic fluid into a cylindrical-shaped screen which is supported above a back-up roll. The back-up roll supports the web which is passed between the rotary screen and the back-up roll. The cylindrical screen includes a doctor blade which receives the hydrophobic material and fills the holes within the cylindrical screen. The holes in the screen are small enough and the hydrophobic material is of sufficient viscosity that the hydrophobic material will not flow through the holes in the screen on its own. The doctor blade forces the hydrophobic material to fill up the screen holes such that a meniscus of material hangs down from the screen toward the back-up roll. As the screen and back-up roll rotate, the screen contacts the web substrate at the point of the back-up roll and transfers the hydrophobic material out of the screen hole and onto the web substrate.

The holes in the cylindrical screen can be varied to produce patterns of printed hydrophobic material in the shape of dots, circles, lines, dimples, hairs, filaments, or any combination of patterns. The printed pattern typically is raised .05 to 3 millimeters above the web surface. The height of the printed material provides a void area for quickly collecting fluid, but it is dry to the touch because the top surface of the hydrophobic printed material retains no fluid. The printed pattern of hydrophobic material improves the tactile impression by creating a surface which is soft to the touch. Dyes or fillers can be added to the hydrophobic material to improve the fluid masking attributes of the web surface by disguising the soiling pattern of the absorbent device created by bodily fluids.

Consequently, it is an object of the invention to provide an absorbent device having improved dryness and tactile attributes of the topsheet web when the topsheet web comprises a tissue or a non-woven material. It is yet another object of the

invention to provide an absorbent device having an improved tactile impression of the topsheet when the topsheet comprises a formed film material.

It is still another object of the invention to provide an absorbent device having improved masking and fluid acquisition characteristics of the topsheet when the topsheet consists of tissue, non-woven or formed film material.

Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings, in which it is understood to be illustrated by a sanitary napkin, but generally applicable to all disposable absorbent devices.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of an absorbent device;

Fig. 2 is a top view of a fluid absorbing web structure of the absorbent device of Fig. 1;

Fig. 3 is a side view of the web structure of Fig. 2;

Fig. 4 is a side view of an alternative embodiment of the web structure of Fig. 2;

Fig. 5 is a second alternative embodiment of the web structure of Fig. 2;

Fig. 6 is a photograph of the web structure of Fig. 3;

Fig. 7 is a photograph of the web structure of Fig. 4;

Fig. 8 is a photograph of the web structure of Fig. 5; and

Fig. 9 is a schematic illustration of the method for producing the web structure of Fig. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention provides for an absorbent device and a method of improving the dryness and tactile attributes of the web substrate which is in contact with the skin of a user. Fig. 1 illustrates the invention as incorporated into a sanitary napkin 10. The sanitary napkin generally comprises a web substrate 12, commonly referred to as a topsheet, a backsheet 14, and a storage component 16 located in between topsheet 12 and backsheet 14. Although the present invention is illustrated in Fig. 1 as a sanitary napkin, it is to be understood that the invention is not so limited to applications of sanitary napkins, but is equally applicable to all absorbent devices including for example diapers and incontinence products.

Topsheet 12 has been cutaway to more clearly show the storage component 16 of the sanitary napkin 10. Topsheet 12 can be made from a web material such as tissue, non-woven or formed film materials. Tissue and non-woven topsheets can

contain all natural fibers, such as wood pulp, or synthetic fibers, or any combination of natural and synthetic fibers. The exact formulation of fibers is not critical to the present invention and can be generally any combination which provides a fluid-pervious topsheet which are well known in the absorbent device art. A formed film topsheet is exemplified by that disclosed in U.S. Patent No. 4,342,314 issued to Radel, et al. on August 3, 1982, said patent being hereby incorporated by reference.

Storage component 16 similarly can comprise natural, synthetic or any combination of natural and synthetic fibers well known in the art. Backsheet 14 can be any of a number of plastic materials, also well known in the art which generates the properties of being fluid-impervious to prevent the absorbed bodily fluid from migrating out of the absorbent device.

Referring to Fig. 2, a plurality of hydrophobic projections 18 are positioned on web 20. It is to be understood that web 20 can consist of tissue, non-woven or formed film material. Hydrophobic projection 18 can be any material that can be printed or sprayed, and include, but are not limited to, thermal plastics and hot melts resins. Preferred resins for application on formed films are resins produced by the H.B. Fuller Company of Vadnais Heights, Minnesota, specifically Resin Numbers HL1412-X and HL1424-X. Preferred resins for applying to non-woven or tissue webs are resins produced by either Century International Adhesives and Coatings, Inc. of Columbus, Ohio, specifically Resin Number CA X 1064-1, or Eastman Chemical Products, Inc. of Kingsport, Tennessee, specifically Resin Eastobond A-3. With respect to formed film webs such as polyethylene, polypropylene polyester, or other thermal plastic films, the surface tension of the resin to be applied must be lower than the surface tension of the formed film web. Additionally the melting point of the formed film should be at least 10° C higher than the melting point of the resin which is joined to the film to ensure that the film is not melted when the hydrophobic material is applied.

The hydrophobic projections 18 are arranged to create land areas 22 on the web, between individual projections, for collection and absorbing of bodily fluid. Because the hydrophobic projections do not absorb fluid, they funnel fluid towards the land area increasing the fluid acquisition rate of web 20. Bodily fluid can have a tendency to sit on the surface of a web or roll off the sides of the web before it can be absorbed, and the hydrophobic projections deter fluid from moving laterally on the surface of the web 20 by forming barriers and thereby allowing the fluid to be absorbed by web 20. For tissue and non-woven webs consisting of natural or synthetic fibers, the closeness of the fibers in the web dictates how the web will absorb and move bodily fluids into the storage component. Consequently, the

hydrophobic projections 18 are positioned only on the surface of web 20 such that the projections do not penetrate into the web and affect fluid wicking channels between individual fibers in the web.

As shown in Fig. 3 projections 18 are raised .05 to 3 millimeters above the surface 24 of web 20. By raising projections 18 above the surface 24 of web 20, valleys or void areas 26 are created between individual projections for collecting bodily fluid to be absorbed. The dry attributes of web 20 are improved because bodily fluid is maintained in valley 26 temporarily before being absorbed, and away from the skin of the user. Consequently, projections 18 separate the fluid from the user and keep the user dry and clean. By applying hydrophobic projections 18 on the surface of tissue and non-woven webs, the individual web fibers at their tips which are in contact with the user, becomes hydrophobic thereby directing the bodily fluid through the web and into the storage component without remaining on the web surface. In addition by joining the hydrophilic projections to the web surface as a separate component, as opposed to being integral, projections of hydrophobic material can be used in conjunction with hydrophilic webs such as tissue or non-woven material. Also projections with varying degrees of hydrophobicity can be used in conjunction with webs exhibiting varying degrees of hydrophobic or hydrophilic characteristics. Preferably the density of the projections on the web surface range from about 1,600 to about 10,000 projections per square inch.

As shown in Figs. 2, 3 and 6, hydrophobic projections 18 can be applied as dots. It is to be understood, however, that hydrophobic projections 18 can be applied as dots, circles, lines, dimples, hairs, filaments or any combination of patterns. The patterns can be distributed uniformly over the web surface 24, or randomly. When hydrophobic projections are applied as dimples, they can be in any shape, such as oval, round, diamond, pyramidal, or square shaped. In any shape or pattern, the hydrophobic projections provide a void area for quickly collecting fluid, but remain dry to the touch because the top surface of the projections retain no fluid.

Softness of web 20, commonly referred to as tactile impression, is improved by placement of the hydrophobic projections on the surface in regular or random pattern form. Although hydrophobic projection 18 applied as dots increase the tactile impression of the web 20, the preferred form of hydrophobic projections 18 for the greatest tactile impression is achieved when hydrophobic projections 18 are formed as hairs 28 as shown in Figs. 4 and 7. Hairs 28 as shown in Fig. 7 extend perpendicularly, as well as non-perpendicularly away from web surface 24. The advantage achieved with hairs is that a larger number of projections can be applied to the surface 24 of web 20 thereby generating a softer feel. Hair projections, unless

applied in a very thick caliper can collapse when placed in contact with the user. Collapsed projections may interfere with fluid absorption and the dryness attributes at the web 20.

To maximize both the dryness and tactile attributes of web 20, the hydrophobic projections preferably are applied as filaments 30 as shown in Figs. 5 and 8. Filaments 30 are essentially shorter, thicker hairs which remain perpendicular to web surface 24. Filaments 30 are more resistant to being compressed by the user because they are thicker and shorter than hair projections 28.

Masking capabilities of web 20 can be enhanced by the addition of a dye or filler to the hydrophobic projections 18. Suitable masking agents could be titanium dioxide (TiO_2) or calcium carbonate ($CaCO_3$). The hydrophobic projections themselves, as well as the fillers aid in the masking of bodily fluids absorbed by the web and retained in the storage component. The masking agent creates a clean appearance because the user cannot see through the web.

Referring to Fig. 9, the preferred method for applying the hydrophobic projections to the web surface is by a rotary screen printing method. Although the preferred method for applying the hydrophobic projection is hereinafter discussed with respect to the rotary screen printing method, it is to be understood that other methods of printing or spraying hydrophobic projections are contemplated by the invention. Such methods include spiral spraying, mist spraying or line spraying, gravure printing, and flexographic printing. Rotary screen printing is the most preferred because the method can be performed at high web line speeds.

Rotary screen printing is accomplished by passing web 20 from a stock roll 32 of web material between a rotary screen cylinder 34 and a back-up roll 36. Web 20 is unwound from stock roll 32 by drive cylinder 38. Rotary screen cylinder 34 is loaded with hydrophobic material such as molten resin through slot extruder 40 attached to screen cylinder 34. Doctor blade 42 forces the hydrophobic material from slot extruder 40 into holes in rotary screen 34. Rotary screen 34 has a thickness of approximately 4 to 7 millimeters. The doctor blade fills the small screen holes with the hydrophobic material, which is of sufficient viscosity that it will not flow right through the screen holes, and forces enough hydrophobic material into the screen such that a meniscus of fluid extends downwardly from the screen holes as the screen rotates. As the web passes between rotary screen cylinder 34 and back-up roll 36, which is also rotating, the rotary screen contacts the web at the point of the back-up roll and the meniscus of hydrophobic material transfers from the screen onto web 20. The hydrophobic material is literally pulled out of the screen by the web as it passes

between the rotary screen and the back-up roll. The holes in the rotary screen are continuously refilled by doctor blade 42.

To print the dot pattern of hydrophobic projections on the web 20, the web line speed is equal to the speed at which the rotary screen rotates. To print the hair pattern of hydrophobic projections, the web line speed is increased one-half to one percent above the rotational speed of the rotary screen. Since the web is moving faster than the rotary screen, the web will pull the hydrophobic material out of the screen such that the hair pattern is formed. To form the filament hydrophobic pattern, cold air is pumped from nozzle 44 directly onto the web immediately after the hydrophobic material is transferred from the rotary screen cylinder onto the web. The cold air freezes the hydrophobic material in the filament pattern, thereby preventing the hydrophobic material from forming the hair pattern. Alternatively, back-up roll 36 can be chilled to freeze the hydrophobic material into the filament pattern instead of pumping cold air through a nozzle.

While the invention has been described in conjunction with an absorbent device having improved dryness and tactile attributes, it is to be understood that alternatives, modifications and variations will be apparent to those skilled in the art in light of the foregoing description. Accordingly, the invention is intended to embrace all such alternatives, modifications, and variations as fall within the spirit and broad scope of the appended claims.

What is Claimed is:

1. A topsheet for an absorbent device, said topsheet comprising:
   a substrate, said substrate having a body facing surface; and
   a plurality of hydrophobic projections joined to said body facing surface of said substrate, said projections providing a soft tactile impression and defining void areas for collection of body fluid.
2. The topsheet of Claim 1, characterized in that said substrate comprises tissue, a non-woven material, or a formed film.
3. The topsheet of Claims 1 and 2 characterized, in that said hydrophobic projections comprise dots, hairs, or filaments.
4. An absorbent product having an improved tactile impression, comprising:
   a fluid absorbing web structure, the web structure having a body facing surface;
   a storage component;
   a fluid impervious backsheet; and
   a plurality of hydrophobic projections joined to and extending outwardly from said body facing surface, the plurality of projections being adapted to contact a user and to separate the user from the body facing surface, said projections further defining a plurality of fluid containment areas between the projections for collecting and temporarily containing fluid emanating from the user, whereby the plurality of hydrophobic projections separate the fluid from the user and impart comfort properties to the user.
5. The absorbent product of Claim 4, characterized in that said hydrophobic projections extend .05 millimeters to 3 millimeters above said body facing surface.
6. The absorbent product of Claims 4 and 5, characterized in that said hydrophobic projections are a resin.
7. The absorbent product of Claim 6, characterized in that said hydrophobic projections further includes a masking agent.
8. A method for improving the dryness and tactile attributes of an absorbent product topsheet web comprising the steps of:
   joining a plurality of hydrophobic projections to a body facing surface of said topsheet;

said joining step further comprising the steps of passing said topsheet between a rotary screen cylinder and a back-up roll at a rate constant to a rotational rate of said rotary screen cylinder, and transferring said hydrophobic material from said rotary screen cylinder to said topsheet web.

9. The method of Claim 8 further comprising the step of increasing the rate at which said topsheet web is passed between said rotary screen cylinder and said back-up roll.

10. The method of Claims 8 and 9 further comprising the step of cooling said topsheet web immediately after said hydrophobic material is transferred.

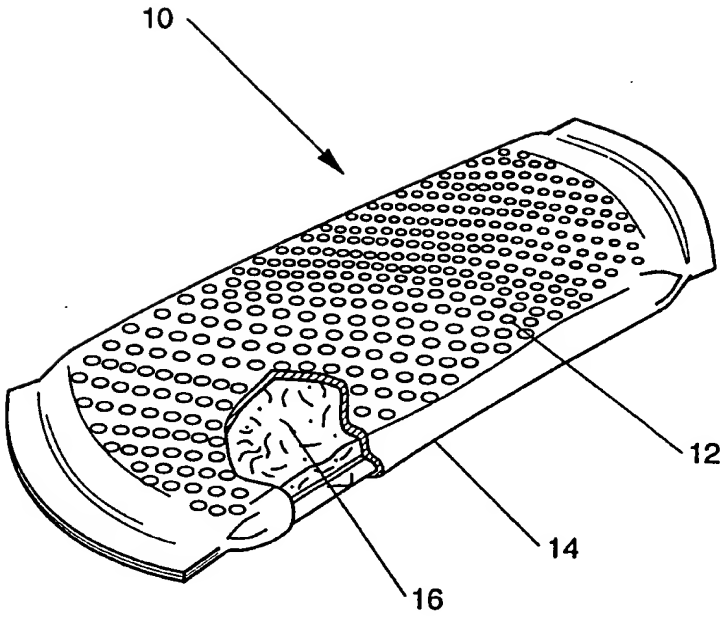


Fig. 1

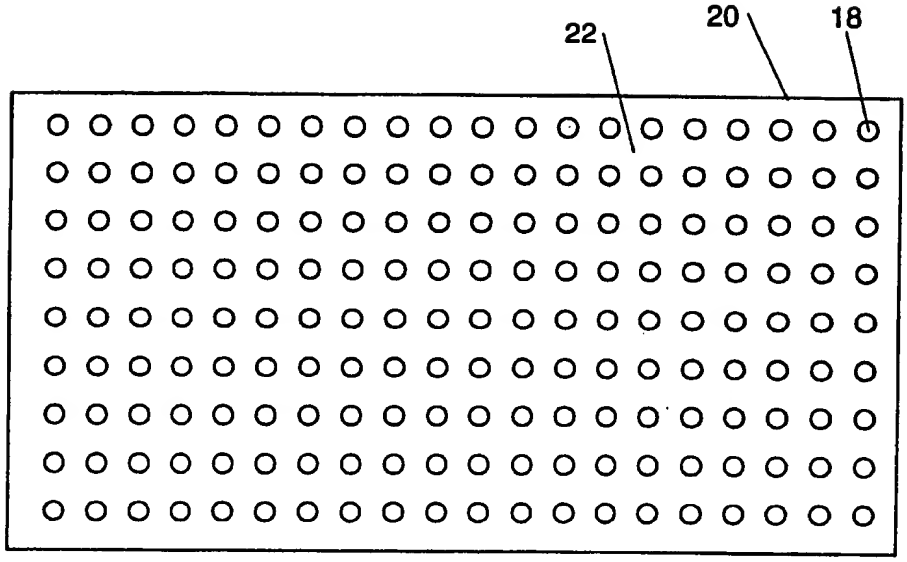


Fig. 2

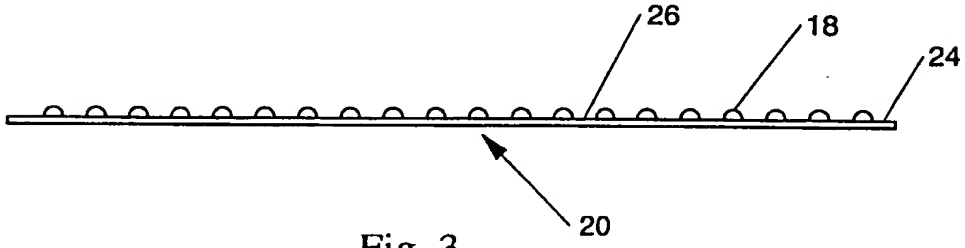


Fig. 3

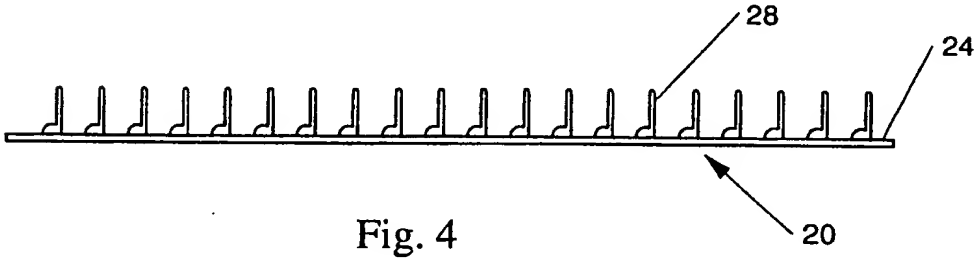


Fig. 4

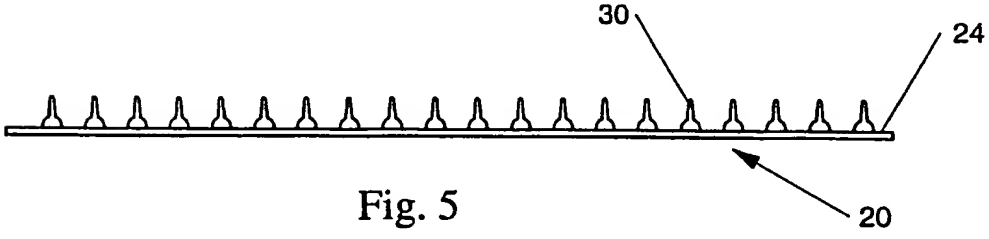


Fig. 5

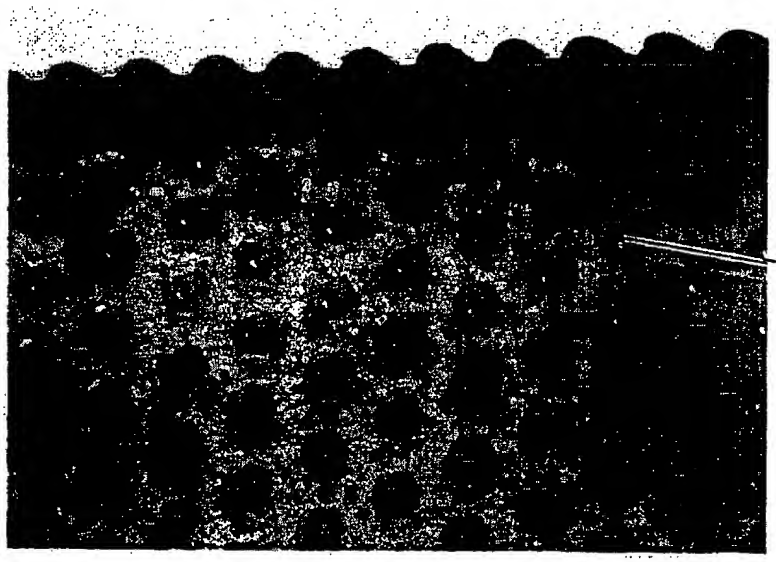


Fig. 6

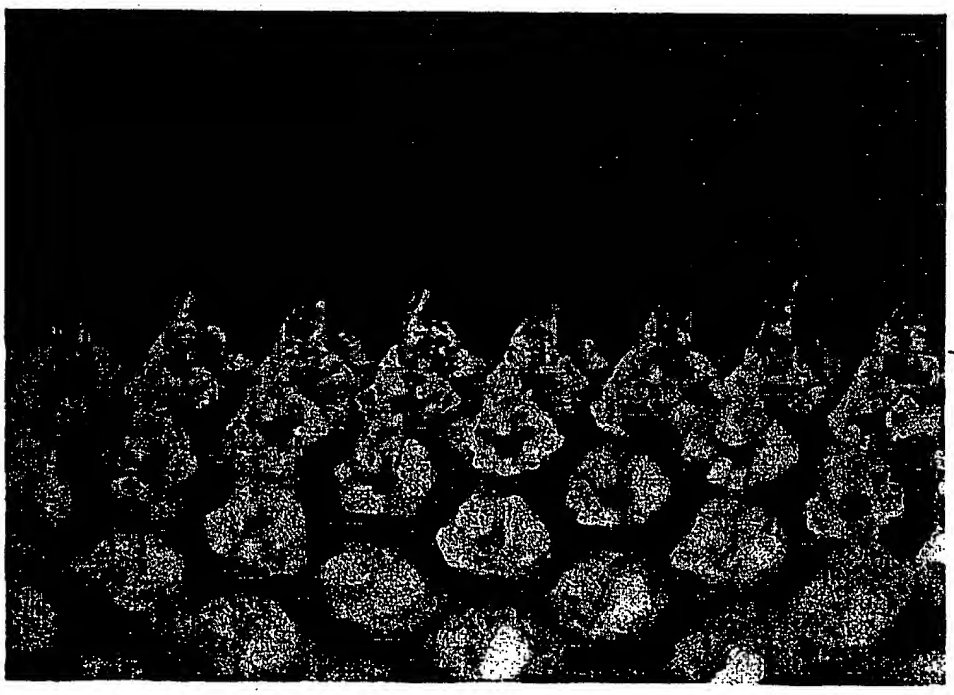


Fig. 8

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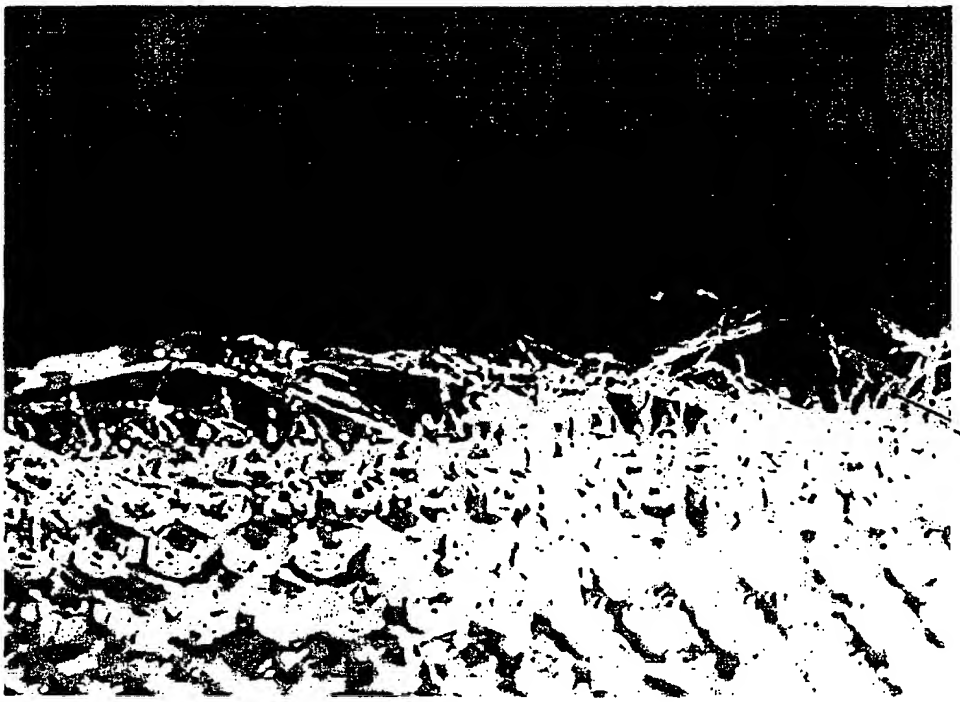

Fig. 7

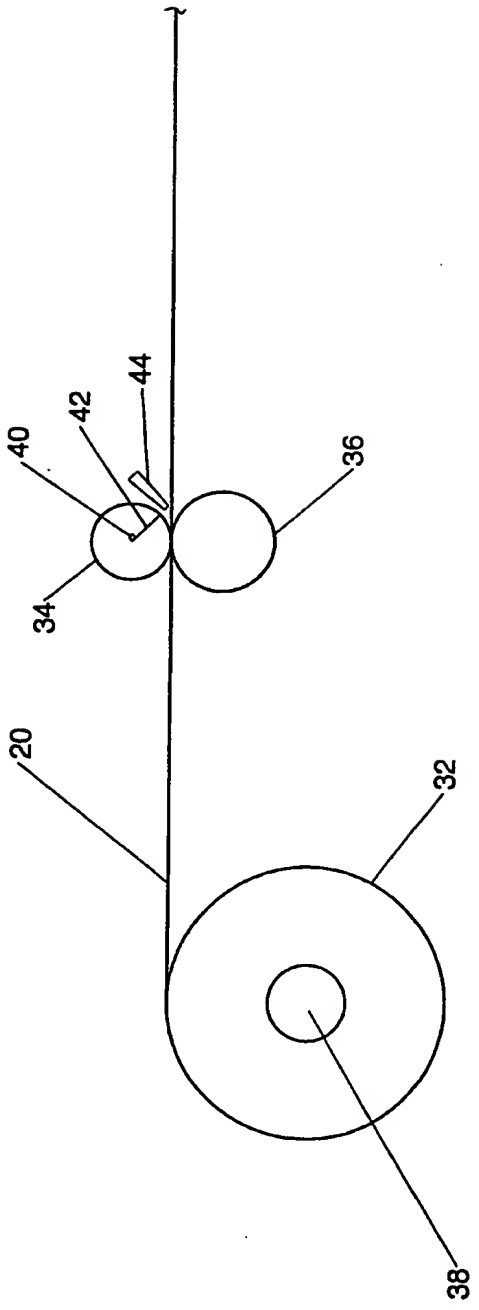

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 96/09074

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A61F 13/46, A61F 13/15
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO, A1, 9420054 (MÖLNLYCKE AB), 15 Sept 1994 (15.09.94), page 2, line 21 - page 3, line 29 --	1-10
A	DE, A1, 4321155 (VP-SCHICKEDANZ AB), 5 January 1995 (05.01.95), page 3, line 1 - line 48, figures 2-4 --	1-10
A	WO, A1, 9515138 (KAYSERSBERG), 8 June 1995 (08.06.95), abstract --	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search	Date of mailing of the international search report
9 Sept 1996	01. 10. 96
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